MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

EEM1016 – ENGINEERING MATHEMATICS I

(All sections / Groups)

16 OCTOBER 2017
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTION TO STUDENT

1.This Question paper consists of 4 pages (including cover page) with 5 Questions only.

2. Attempt ALLquestions. The distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

4. Only NON-PROGRAMMABLE calculator is allowed in the examination.

Question 1

(a) Evaluate the following limits:

(i) $\lim_{x\to 2}\left(\frac{\sqrt{x^2+5}-3}{x^2-2x}\right)$ [2 marks]

(ii) $\lim_{x\to 3}\left(\frac{1}{x^2-7x+12}\right)$ [2 marks]

(b) Let $f(x)=\frac{x^2}{x-1}$

(i) Find $f'(x)$ [2 marks]

(ii) Identify the critical points of $f(x)$ [3 marks]

(iii) Determine whether the critical point is a local maximum, local minimum or point of inflexion. [3 marks]

(c) Evaluate the following integral:

(i) $\int \frac{x^{0.5}}{x+1}\,dx$ [4 marks]

(ii) $\int_4^{\infty} \frac{1}{x(\ln x-1)^3}\,dx$ [4 marks]

Question 2

(a) Determine whether the following sequence converges, and if it does, find the limit.

$a_n=\frac{n^2+5}{\sqrt{4n^4+n}}$ [3 marks]

(b) Determine whether the following series is convergent.

$\sum_{n=1}^{\infty}\frac{n}{(n+1)!}$ [4 marks]

(c) Find the radius and the interval of convergence of the following power series:

$\sum_{n=1}^{\infty}\frac{3^n x^n}{2n-1}$ [7 marks]

(d) Given that $\frac{1}{1+x}=\sum_{n=0}^{\infty}(-1)^n x^n$, $|x|<1$,

approximate $\int_0^{0.3}\frac{1}{1+x^3}\,dx$ to 4 decimal points. [6 marks]

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Question 3

(a) Let $z = \dfrac{2+3i}{4-2i} + 4i$. Find

(i) Complex conjugate of z and $\bar{z}$ [3 marks]

(ii) Polar form and exponential form of z [3 marks]

(iii) Cube roots of z and $z^{1/3}$ [4 marks]

(b) Given three vectors $a = \hat{i} + 3\hat{j} - 2\hat{k}$, $b = -2\hat{i} + 2\hat{j} + \hat{k}$ and $c = 3\hat{i} - \hat{j} + 3\hat{k}$, find the volume of the parallelepiped determined by these three vectors. [2 marks]

(c) Points A, B and C are at coordinates (1, 3, −1), (−3, 2, 1) and (2, −5, 3), respectively.

(i) Find the equation of the plane containing A, B and C. [6 marks]

(ii) Determine the shortest distance from the point (3, 2, 1) to the plane in part (i). [2 marks]

Question 4

(a) The speed of the water is given by the function, $s = \sqrt{u^2 + v^2}$, where the velocity are $u = 4 \cos\pi x \sin\pi y$ and $v = -3 \sin\pi x \cos\pi y$, respectively. By using the chain rule, find $\dfrac{\partial s}{\partial x}$ and $\dfrac{\partial s}{\partial y}$. [5 marks]

(b)

(i) Find an equation of tangent plane to the following surface at the given point:

$$z = f(x, y) = \tan^{-1}(x + y)\ ;\ (0, 0, 0).$$ [4 marks]

(ii) Use the answer in part (i) to approximate (0.01, −0.02). [2 marks]

(c) Use Lagrange multipliers to find the maximum and minimum values of the following function f:

$$f(x, y) = x + 4y \quad \text{subject to} \quad g(x, y) = x^2 + 2y^2 = 36.$$ [9 marks]

Continued...

Question 5

(a) Find the period of the following function $f(x)$ and determine the integration of the function.

$\int_{-\pi}^{\pi} f(x)dx \ , f(x) = (cos2x)^2 sinx$ [2 marks]

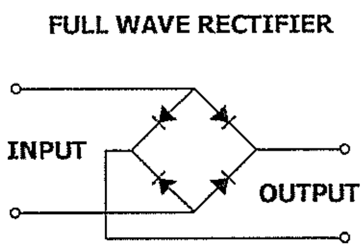
(b) Solve the following integrations:

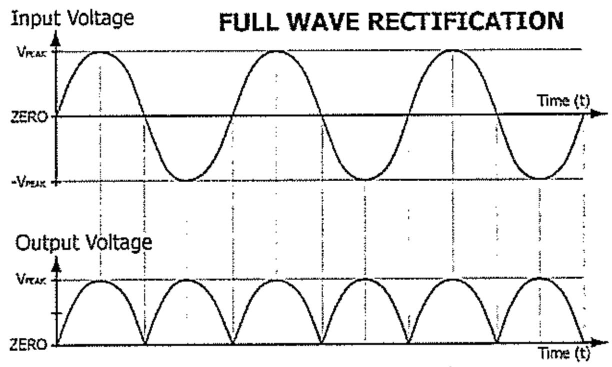
(i) $\int \sin t \sin nt \, dt$ [4 marks]

(ii) $\int \sin t \cos nt \, dt$ [4 marks]

(c) One of the very important applications of diode is in DC power supply as a rectifier to convert AC into DC. DC Power supply is the important element of any electronic equipment. This is because it provides power to energize all electronic circuits like oscillators, amplifiers and so on. The first block of DC power supply is rectifier. The figure bellows shows the Bridge rectifier, which converts an AC voltage to DC voltage using both half cycles of the input AC voltage. The period for the input voltage is 2π and the amplitude $V_{max} = 1$ Volt.

Determine the Fourier series representation of the output voltage. [10 marks]





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